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NOTES FROM PACIFIC COAST OBSERVATORIES.

NOTE ON MT. HAMILTON WEATHER.

The Lick Observatory is now passing through the most severe snow blockade that it has experienced at least since 1889-90. Between January 12th and 16th the snowfall exceeded fifty inches. The latter part of the fall was attended by considerable wind, and long stretches of the road were drifted full. The snowfall was remarkable for the low altitude to which it descended. At Smith Creek it amounted to eighteen inches, and the fall extended down to within one hundred or two hundred feet of the level of the Santa Clara Valley. No stage has reached the summit since January 12th, and at the date of writing, January 22d, we are not expecting the stage to come to the summit for another week at least. The wires which gave us telephone connection with the outside world were broken down under the great weight of snow and ice which collected on them. On two days we did not attempt to communicate with the stage, which ascended as far as Smith Creek. On other days the mails and supplies were carried up over the snow by members of the staff. Fortunately, no illness developed, and the inconvenience of the blockade has thus far not been serious.

The winter has been unusually cold, stormy, and cloudy. The precipitation to date corresponds to about twenty-one inches of rainfall.

W. W. CAMPBELL.

ON THE RELATION BETWEEN STELLAR SPECTRAL TYPES AND THE INTENSITIES OF CERTAIN LINES IN THE SPECTRA.[1]

During the past summer, in connection with the measurement of spectrograms obtained at the Mills Observatory in Chile by Professor WRIGHT, an investigation of the individual spectrum lines was begun, with a view of determining whether there is a shift of any of the lines which is progressive from spectral type to type. Several lines were found which undergo such a progressive change, as is indicated by the radial velocities obtained from them. An examination of ROWLAND'S tables shows that in most but not all cases studied lines apparently single are in reality blends of two or more close components. The nature of the variations found is such as to indicate varying intensities of the same components rather than the presence or absence of different components in the different types. It was the intention, when sufficient data had been obtained, to make comparisons with the enhanced and weakened lines in the spark and arc spectra. When a list of sun-spot lines[1] in the region covered by the Southern Mills plates became available, a comparison with these was made instead. The investigation was limited to stars of types F to Mb inclusive on the Harvard classification. In this classification the Sun is of type G.

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[1] A more complete account of this investigation is published in *Lick Observatory Bulletin,* No. 106, and in *Astrophysical Journal,* Vol. 24, p. 333, 1906.

The principal result of the comparison is the very strong indication that the physical conditions in the stars as we pass from the F to the Mb type vary in the same direction as from the Sun to the sun-spots. It is not intended to convey the impression, however, that any one type has been found in which the conditions are exactly the same as in the sun-spots, though an early K type is probably nearest to it. In the Mb type the relative intensities of the lines as shown, both by their appearance and their residuals, have gone far beyond what they are in the Sun, whereas in the F type they much precede the condition in the solar spectrum. ADAMS has shown a striking similarity to exist in the intensities of sun-spot lines and of the corresponding lines in the spectrum of *Arcturus* (type K), while HALE and ADAMS[2] have made a similar comparison of intensities for α *Orionis* (type Ma) in the region λ 5393 to λ 5703.

A large number of lines might be mentioned which change greatly in intensity and appearance as we proceed from the F to the Mb type, this change being frequently very prominent even from the G to the K type, and which are not included in ADAMS'S list of lines affected in sun-spots. Among the most striking of these are the Cr lines, λ 4254.5 and λ 4274.9, which become very strong, wide, and diffuse as we follow the scale of stellar types. A few cases of contradictory evidence have also been found, in which the residuals show a decided shift in the opposite direction from that which would be expected from the intensities assigned to the components in sun-spots. Among these the line λ 4435.2 may be especially mentioned. For this blend both my value of the wave-length, as determined from the spectrograms, and the progressive trend of the residuals indicate a shift of its center toward the violet instead of toward the red. Some of the observed differences between sun-spots and stellar K type, in which the physical conditions may be similar, may be due to the fact that in the stars this condition is the average condition in their entire atmospheres, while in the case of the sun-spots some effects may be altered by overlying layers of gases and vapors or by other local circumstances. Nevertheless the similarities are sufficiently striking to promise much for this line of study. The results here given depend not only upon the appearances of the lines, but primarily upon quantitative measurements of their positions.

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[1] "Sun-spot Lines in the Spectrum of *Arcturus*," by WALTER S. ADAMS, *Astrophysical Journal*, Vol. 24, p. 69, 1906.

[2] *Astrophysical Journal*, Vol. 23, p. 400, 1906.

It was thought possible that for variable stars of large light changes traces of velocity variations of some of the lines might be found, corresponding to small changes in spectral type as the stars varied from maxima to minima and *vice versa.* In the case of *o Ceti* actual changes in the character of the spectrum are well-established facts, though up to the present no appreciable changes in the wave-lengths of any of its spectrum lines have been observed—leaving out of account the large displacements of the bright hydrogen lines. A comparison of the available measures of *η Aquilæ,* a variable star of the fourth class with a range of only 0.8 of a magnitude in light variation, showed evidences of variations in the positions of some of its lines from light maximum to minimum similar to the variations that were found from type to type. A further study of this variable star is desirable to establish definitely the exact character and amount of these variations.

The following few examples are typical of the progressive variations that were found for the different types. The intensities in the Sun are ROWLAND'S, and those in sun-spots and in *Arcturus* are taken from ADAMS'S article (*l. c.*).

λ 4352.908 Fe—Intensity in Sun, 4 } In sun-spots, 6-7; in *Arcturus,* 7-8;
53.044 V —Intensity in Sun, 0 } widened toward red.

Residuals (in km.) :—

F	F8G and F8G Pec.	G	G5K	K		K2M and K5M	Mb
— 3.0	— 3.7	+ 0.8	— 0.7	+ 1.6	+ 2.1	+ 3.6	+ 3.4
	+ 1.5	+ 1.0	— 0.6	+ 3.1	+ 3.4	+ 3.0	+ 4.9
	— 1.0	+ 1.7	+ 2.2	+ 0.8	+ 2.6	+ 3.0	+ 4.6
	+ 1.5	— 1.1	+ 2.8	+ 1.4	+ 1.4	+ 1.0	+ 4.7
	— 3.5		± 0.0	+ 2.6	+ 4.8	+ 3.9	+ 3.9
			+ 1.7	+ 3.1	+ 2.2	+ 2.2	+ 6.5
				+ 1.5	+ 0.8	+ 4.4	
				+ 2.2	— 0.2	+ 3.3	
				+ 0.8	+ 4.3	+ 3.0	
				+ 2.0	+ 1.9		
				+ 0.9	+ 3.2		
					+ 3.6		
Means:							
.....	— 1.0	+ 0.8		+ 2.2		+ 3.0	+ 4.7

λ 4468.663 Ti—Intensity in Sun, 5; in sun-spots, 4-5; in *Arcturus,* not affected.

Residuals :—

F	F8G	G	G5K	K		K5M	Mb
— 1.3	— 2.2	— 0.3	+ 1.4	+ 2.8	+ 2.7	+ 5.7	+ 6.8
— 4.1	— 0.3	— 1.5	+ 0.9	+ 2.6	+ 3.7	+ 0.8	+ 7.0
+ 1.7	— 2.9	— 0.9	— 0.7	+ 3.9	+ 4.3	+ 6.3	+ 3.5
— 3.0	— 0.9		— 0.9	+ 1.1	+ 1.5	+ 2.5	+ 6.1
— 3.7	+ 1.4		+ 2.7	+ 1.0	— 0.3	+ 4.7	+ 4.8
			— 2.1	+ 0.6	+ 1.9	+ 4.7	+ 1.9
				+ 2.2	+ 0.6	+ 4.7	+ 1.7
				+ 0.4	+ 0.4	+ 5.2	+ 5.9
				— 0.4	— 1.5		
				+ 1.2	— 3.0		
				+ 1.3	+ 3.3		
				+ 0.7	— 0.1		
Means:							
— 2.1	— 1.0	— 0.9	+ 0.2	+ 1.3		+ 4.3	+ 4.7

λ 4314.964 Ti—Intensity in Sun, 1 }
15.138 Ti—Intensity in Sun, 3 } Not included in list of sun-spot lines.
15.262 Fe—Intensity in Sun, 4 }

Residuals :—

	F	G	K	K5M	Mb
Means:	+ 1.1	— 1.4	— 2.0	— 2.7	— 5.0

λ 4435.129 Ca—Intensity in Sun, 5; in sun-spots, 6 }
.32 Fe—Intensity in Sun, 2; in sun-spots, not affected. } In *Arcturus,* 8.

Residuals :—

	F	F8G and G	G5K and K	K5M	Mb
Means:	— 4.0	— 1.7	+ 0.3	+ 2.5 ±	+ 1.8 ±

The establishing of these variations in the wave-lengths of some of the lines with spectral type will make necessary the exercise of great care in the selection of lines in radial velocity determinations, and a proper allowance for the type.

MT. HAMILTON, December 14, 1906. SEBASTIAN ALBRECHT.

HONORS CONFERRED UPON PROFESSORS AITKEN AND HUSSEY.

The Paris Academy of Sciences has conferred the Lalande Prize for 1906 upon Professor R. G. AITKEN, of the Lick Observatory, and Professor W. J. HUSSEY, formerly of the Lick Observatory, and now Director of the Detroit Observatory at Ann Arbor. The prize usually consists of a gold medal and a small sum of money. It has on several occasions been divided between two astronomers, as in the present case.

The following paragraphs are translated from the report of the award published in *Comptes Rendus* for December 17, 1906:—

"No branch of sidereal astronomy presents to-day a higher interest than that relating to the study of double or multiple stars.

"Among contemporary astronomers who have undertaken this study with success, Messrs. R. G. AITKEN and WILLIAM J. HUSSEY,[1] astronomers in the Lick Observatory, are in the first rank, because they have each discovered more than 1,200 new doubles;[2] and in almost three fourths of these pairs the distance of the components is less than two seconds of arc.

"These astronomers have, moreover, measured with care all these pairs in such a manner as to fix the present relative positions of the components.

"In addition, they have made observations upon the fainter satellites of *Jupiter, Saturn,* etc.

"These are results of the highest importance, and the Commission proposes to divide the Lalande Prize between Messrs. R. G. AITKEN and W. J. HUSSEY.

"The conclusions of this report are adopted by the Academy."

W. W. CAMPBELL.

MT. HAMILTON, January 22, 1907.

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[1] Professor HUSSEY has recently left the Lick Observatory, in order to become Director of the Detroit Observatory of the University of Michigan.—*Comptes Rendus.*

[2] The number 1,200 refers necessarily to those published. Professor AITKEN, up to 1907, has discovered more than 1,500 double stars, and Professor HUSSEY had discovered more than 1,300 up to the time of his departure in June, 1905.—W. W. C.